REMARKS

Reconsideration is respectfully requested in view of any changes to the claims and the remarks herein. Please contact the undersigned to conduct a telephone interview in accordance with MPEP 713.01 to resolve any remaining requirements and/or issues prior to sending another Office Action. Relevant portions of MPEP 713.01 are included on the signature page of this amendment.

Rejection under 35 U.S.C. 103(a)
Obviousness

Claims 101-184 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Mourou et al. in U.S. Patent No. 5,656,186 in view of Portney et al. in U.S. Patent No. 5,053,171 or Bennin et al. in U.S. Patent No. 5,160,823. In making this rejection the Examiner is confusing the "focal point " of a lens with the "focus" of a lens. They are not the same thing or at the same location for an object that is at a finite distance from the focusing lens. For an object (such as a lithographic mask) that is a finite distance from a converging focusing lens the focus of the object as an image is at a greater distance from the lens than the focal point is from the lens. The Examiner states:

> Mourou et al. discloses a method for laser induced breakdown of a non-biological material (e.g. gold) material being characterized by a relationship of fluence breakdown at which breakdown occurs versus laser pulse width that exhibits a distinct change of slope at a characteristic laser pulse width, said method comprising the steps of: generating at least one laser pulse which has a pulse width equal to or less than said characteristic laser pulse width. Mourou et al. does not disclose directing or focusing the laser beam to a point above the surface of the material but does disclose that the optics can include a mask (e.g. see figure 6A). .Portney teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece. Alternatively Bennin et al. teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece.

Applicant agrees that "Mourou et al. does not disclose directing or focusing the laser beam to a point above the surface of the material." But applicants disagree that "Portney teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece. Applicants also disagree that Bennin et al. teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece" as asserted by the Examiner. Both Portney et al. and Bennin et al. teach focusing at the surface of the material being acted on an image of a mask. Thus the focus is at the surface of the material and not above it.

Applicants respectfully disagree with the Examiner's statement that "It would have been obvious to adapt Mourou et al. in view of Portney et al. or Bennin et al. to focus the laser beam above the workpiece so that an image of a mask can be ablated onto the workpiece." The Examiner has not made out a prima facie case of obviousness sine the Examiner has not identified where Mourou et al. , Portney et al. or Bennin et al. teach, suggest, provide motivation for "directing or focusing the laser beam to a point above the surface of the material." The Examiner also has not provided a reason for why a person of skill in the art would conceive applicants' invention based on the teaching of Mourou et al., Portney et al. or Bennin et al. and the knowledge of a person of ordinary skill in the art prior to applicants' earliest filing date. In view thereof applicants respectfully request the Examiner to withdraw the rejection of Claims 101-184 under 35 U.S.C. 103(a) as being unpatentable over Mourou et al. in U.S. Patent No. 5,656,186 in view of Portney et al. in U.S. Patent No. 5,053,171 or Bennin et al. in U.S. Patent No. 5,160,823.

In the Summary of the Invention at Col. 1, lines 50 to 61 Mourou et al. teach:

> In one aspect the invention provides a **method for laser induced breakdown of a material with a pulsed laser beam** where the material is characterized by a relationship of fluence breakdown threshold (F_{th}) versus laser beam pulse width (T) that exhibits an abrupt, rapid, and distinct change or at least a clearly detectable and distinct change in slope at a predetermined laser pulse width value. **The method comprises generating a beam of laser**

> **pulses in which each pulse has a pulse width equal to or less than the predetermined laser pulse width value. The beam is focused to a point at or beneath the surface of a material where laser induced breakdown is desired.** (Emphasis added.)

Thus Mourou et al. teaches:

1. laser induced breakdown of a material with a pulsed laser beam;

2. the material is characterized by a relationship of fluence breakdown threshold (F_{th}) versus laser beam pulse width (T) that exhibits an abrupt, rapid, and distinct change or at least a clearly detectable and distinct change in slope at a **predetermined laser pulse width value**;

3. each pulse has a pulse width equal to or less than the **predetermined laser pulse width value**; and

4. the beam is focused at or beneath the surface.

Mourou et al. further teaches at Col. 5, lines 25 to 54:

> In experimental conditions with wavelength of 800 nm and 200 fs pulses on gold (FIG. 3), the absorption depth is 275 A with a diffusion length of 50 A. In the case of nanosecond pulses the diffusion length, which is on the order of 10 .mu.m (micron) in diameter, is much longer than the absorption depth, resulting in thermal diffusion being the limiting factor in feature size resolution. Empirical evidence for the existence of these two regimes is as exhibited in FIG. 3. Here both experimental and theoretical ablation thresholds are plotted as a function of pulse width. An arrow **[predetermined laser pulse width value referred to in the quote above from Col. 1, lines 50 to 61]** at approximately 7 picoseconds pulse width (designated herein as T or .tau..sub.p) delineates the point (or region closely bounding that point) at which the thermal diffusion length (l.sub.th) is equal to the absorption depth (1/a). It is clear that for a smaller size spot a shorter (smaller) pulse is necessary. For spot size on the order of 1000 .ANG. or less, pulse width on the order of 100 femtoseconds or less will be needed. **It is clear from the figure that this is the point [i.e the predetermined laser pulse width value] at which**

the ablation threshold transitions from a slowly varying or nearly constant value as a function of pulse width to one that is dramatically dependent on pulse time. This result is surprising. It has been demonstrated that the electron thermalization time for laser deposited energy in gold is on the order of, or less than, 500 fs and the electron-lattice interaction time is 1 ps. The consequences of this for ultrafast laser pulses is that the energy is contained within the beam spot. **In fact for energies at or near the threshold for ablation, the spatial profile of the laser beam will determine the size and shape of the region being ablated (FIGS. 4 and 5).** (Emphasis added.)

Fig. 3 of Mourou et al. is below. The teaching of Mourou et al. is limited to the regime where there is no heating of the material but laser induced breakdown of the material.

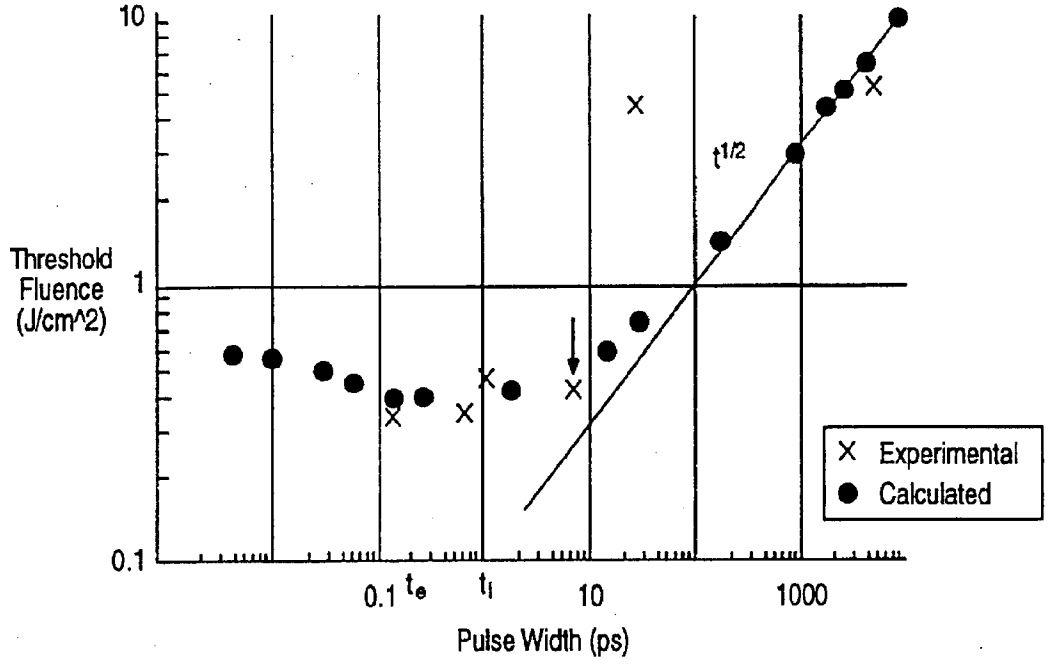
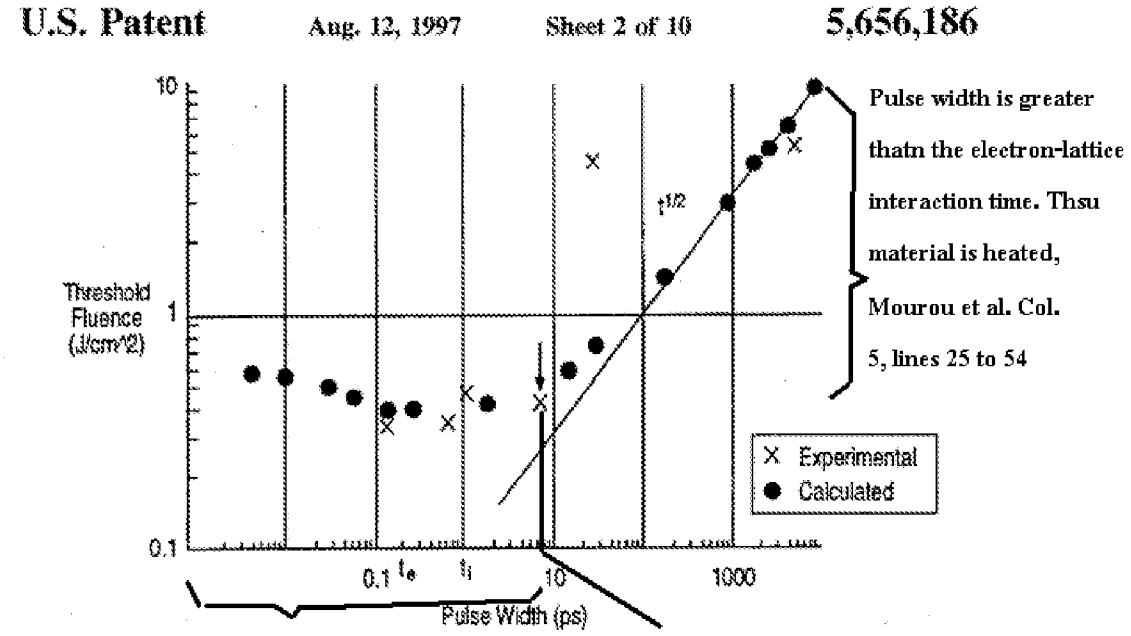


FIG. 3

A person of ordinary skill in the art from the teaching of Mourou et al. is led to believe by the explicit teaching "The beam is focused to a point at or beneath the surface of a material where laser induced breakdown is desired." (Col. 1, lines 50 to 61 Mourou et al.) that no material will be removed by the non-thermal method taught by Mourou et al. that is not at the focus of the laser beam.

The following is a marked up version of Mourou et al. Fig. 3:



Portney et al. teaches laser ablation by heating. Portney et al. teaches Col. 1, line 65 to Col. 2, line 7.

> Finally, a laser beam is masked and focused generally into the form of a hollow cone whose tip is the focal point of the beam. By exposing the workpiece to the beam on one side of the focal point and then on the other, two bevel cuts are made along the perimeter of the upper and lower surfaces, respectively, of the workpiece. When combined with a vertical section of the side of the workpiece, these bevel cuts form an approximation of a rounded edge which is further softened by the slight melting of the workpiece material produced by the **heat generated by the laser during cutting**.

Thus Portney et al. is directed to the portion of Mourou Fig. 3 that is not in the regime of the Mourou et al invention, i.e. laser pulse widths too short for heating of the

material. Thus a person of ordinary skill in the art would not be motivated by the teaching of Portney et al. to change the location of the focus of the laser beam (i.e., Mourou et al. states "The beam is focused to a point at or beneath the surface of a material where laser induced breakdown is desired.") As shown below Portney et al. teaches focusing the laser beam onto the surface to be etched.

Bennin et al. teaches at Col. 4, lines 59-63:

> Synchronously, work piece surface 18 moves with the **mask 15**, in the opposite direction, as indicated in FIG. 2, allowing the identically patterned, but magnified zone of **object image 25** to be ablated from the work piece surface 18.

Bennin et al. teaches at Col. 4, lines 29-38:

> The pattern image on mask 15 at the zone where beam 11 strikes the mask is guided into third turning mirror 16 which turns the projected image 90° into focusing lens 17, mounted on vertical focusing lens Z axis stage 22, which moves perpendicular to the horizontal mask W axis stage 21. Focusing lens 17 inverts, magnifies and projects the image onto the work piece surface 18,

Thus Bennin et al. teaches focusing mask 15 by lens 17 onto surface 18 as image 25. This is the same teaching as Mourou et al. (i.e., Mourou et al. states "The beam is focused to a point at or beneath the surface of a material where laser induced breakdown is desired.") Thus a person of ordinary skill in the art would not be motivated by the teaching of Bennin et al to focus the laser beam above the surface from which material is to be removed. The Examiner has provided no specific argument for why claim 101, or any of the claims should be obvious over Mourou et al. in U.S. Patent No. 5,656,186 in view of Portney et al. in U.S. Patent No. 5,053,171 or Bennin et al. Applicants respectfully submit that the Examiner's rejection is based on incorrectly asserting that the Bennin et al focuses a laser above the surface of the workpiece 18.

Thus the Examiner's statements:

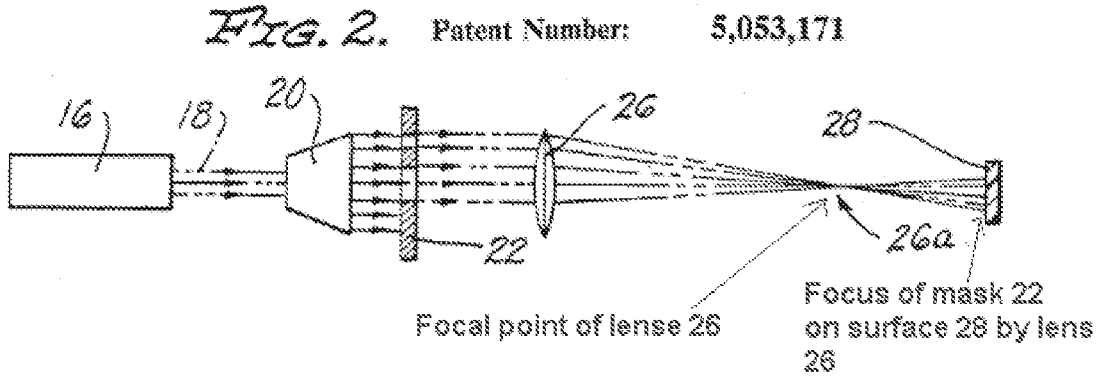
1) "Portney teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece."
2) "Alternatively Bennin et al. teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece."

are not supported by the teaching of Portney which as stated above is directed to laser heating and focusing at the surface, whereas Mourou teach that laser heating is not to be used, and Benin which as stated above is directed to focusing at the surface, which is what Mourou teaches.

In the rejections for independent claims 101, 107, 124, 133, 136, 137, 146, 148, 150, 151 and 154 the Examiner states:

Portney teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece (e.g. see figure 2 and column 3,lines 30-45).

Portney et al. Fig. 2 is:



Portney et al. Col 3, lines 30 – 45, teaches:

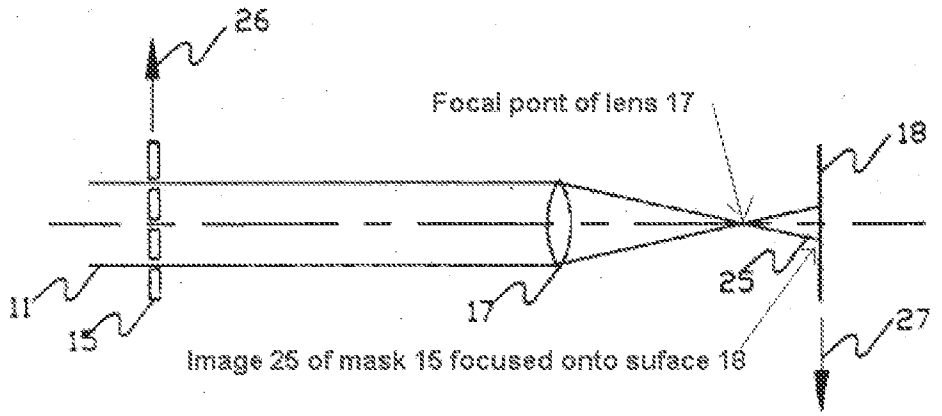
> FIG. 2 shows an arrangement useful in cutting the workpiece 10 from a block of PMMA. An excimer laser 16 emits a beam 18 of coherent ultraviolet light. Because the diameter of beam 18 is fairly small, a conventional laser beam expander 20 is used to expand the beam 18 to a diameter of several centimeters. A mask 22 best shown in FIG. 3 is formed integrally with the beam expander 20 or placed into the path of the expanded beam 18 to allow only a narrow strip of light in the shape of the outline 24 of the workpiece 10 to pass through the mask 22. As shown in FIG. 2, the laser energy entering the mask 22 is collimated.
>
> A beam converger or focusing optic 26 is used to project a reduced image of the outline 24 onto the PMMA block 28.

The image is focused onto the workpiece 28. Thus both Mourou et al. and Portney et al. teach away from Applicants' claimed invention.

In the rejections for independent claims 101, 107, 124, 133, 136, 137, 146, 148, 150, 151 and 154 the Examiner states:

> Alternatively Bennin et al. teaches laser ablation while focusing the laser beam above the surface of the workpiece so that an image of the mask is ablated onto the surface of the workpiece (see figure 2 and column 4,lines 34-38 and column 4,and lines 49-63).

Bennin et al. Fig. 2 is:



Patent Number: 5,160,823

FIG. 2

Bennin et al. Col. 4, lines 34 -38 teaches:

> Focusing lens 17 inverts, magnifies and projects the image onto the work piece surface 18, which is positioned on the horizontal work piece X axis stage 23, which is positioned on the horizontal work piece Y axis stage 24.

There is no teaching of ablation in Bennin et al. Col. 4, lines 34 -38, but it teaches focusing at the surface 18.

Bennin et al. Col. 4, lines 34 -38 teaches:

> FIG. 2 illustrates how mask 15 and work piece surface 25 move relative to one another during the imaging process. The movement along vector 26 illustrates how mask 15 moves in the opposite direction 27 of work piece 18, as a result of focusing lens 17 inverting the object mask image. Referring to FIG. 1 it can be seen how the object mask image is inverted on work piece surface 18. Mask 15 moves (diagonally, vertically or horizontally, according to its programmed pattern), exposing a section of the mask object image to the continuously activated pulsing laser beam. Synchronously, work piece surface 18 moves with the mask 15, in the opposite direction, as indicated in FIG. 2, allowing the identically patterned, but magnified zone of object image 25 to be ablated from the work piece surface 18.

The Examiner is misidentifying the focal point of lens 15 with the focus of the image of the mask 15 which is focused onto the surface 18 that is to be ablated according to the teaching of Bennin et al. Mourou et al. requires that, as quoted above at, Mourou et al. Col. 1, lines 50-61 "The beam is focused to a point at or beneath the surface of a material where laser induced breakdown is desired." Mourou et al. teaches that the beam is focused at or beneath the surface. Bennin et al. all teaches that the mask is focused at the surface 18. Thus Mourou et al. and Bennin et al teach the same thing in regards to focusing. As stated above the Examiner is confusing the focal point of the lens in Bennin with the focus of the image which is at a different location. Thus both Mourou et al. and Bennin et al. teach away from applicants' claimed invention.

At page 16 of the referenced Office Action the Examiner states:

> Applicant has made numerous arguments that for a proper 103 rejection the exact location must be pointed out for the teachings or disclosure in the references. Since MPEP Section 706.02(j) merely states that it is preferable (i.e. not mandatory) for the Examiner to point out the location of the relevant teachings in making a rejection, Applicant is requested to supply citations of pertinent case law (not dicta) or BPAI decisions stating that is mandatory for a proper rejection to point out the exact locations of the relevant teachings.

The rules of practice make it mandatory for the Examiner to specifically identify what the Examiner is relying on when requested by the applicant – see 37 CFR 104 (d) (2) which states:

> When a rejection in an application is based on facts within the personal knowledge of an employee of the Office, **the data shall be as specific as possible**, and the reference must be supported, when called for by the applicant, by the affidavit of such employee, and such affidavit shall be subject to contradiction or explanation by the affidavits of the applicant and other persons. (Emphasis added.)

When an Examiner cites a reference and does not specifically identify the part of the reference that the Examiner is relying on to support an assertion of what it teaches, the

Examiner is relying on facts within the Examiner's personal knowledge which the Examiner must specifically identify when requested by the applicant as required by 37 CFR 104 (d) (2). Unsupported statements by the Examiner are conclusory which cannot be relied upon for an obviousness rejection.

In view of the remarks herein applicants respectfully request the Examiner to withdraw the rejection of Claims 101-184 under 35 U.S.C. 103(a) as being unpatentable over Mourou et al. in U.S. Patent No. 5,656,186 in view of Portney et al. in U.S. Patent No. 5,053,171 or Bennin et al. in U.S. Patent No. 5;160,823.

MPEP 713.01 states in part as follows:

> Where the response to a first complete action includes a request for an interview or a telephone consultation to be initiated by the Examiner, ... the Examiner, as soon as he or she has considered the effect of the response, should grant such request if it appears that the interview or consultation would result in expediting the case to a final action.

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Respectfully submitted,

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